



22116008

**BIOLOGY
HIGHER LEVEL
PAPER 2**

Wednesday 18 May 2011 (afternoon)

2 hours 15 minutes

Candidate session number

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Examination code

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INSTRUCTIONS TO CANDIDATES

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer two questions.
- Write your answers in the boxes provided.



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Please **do not** write on this page.

Answers written on this page
will not be marked.



SECTION A

Answer **all** questions. Write your answers in the boxes provided.

1. The air in urban areas contains a variety of pollutants, including particles of solids and gases. The table below shows the pH of rain in urban areas of New York and rural areas nearby. The concentration of four air pollutants is also shown. The concentrations of gases are measured in parts per billion (ppb).

Area	Lead / $\mu\text{g m}^{-3}$	Nitrogen dioxide / ppb	Nitrous oxide / ppb	Sulfur dioxide / ppb	pH of rain
Urban	0.09	37.7	39.3	18.7	4.3
Rural	0.04	6.2	0.5	2.3	4.2

[Source: JW Greg, *et al.*, (2003), *Nature*, **424**, pages 183–186]

- (a) (i) Compare the acidity of rain in urban and rural areas.

[1]

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- (ii) Compare the levels of atmospheric pollution in urban and rural areas.

[2]

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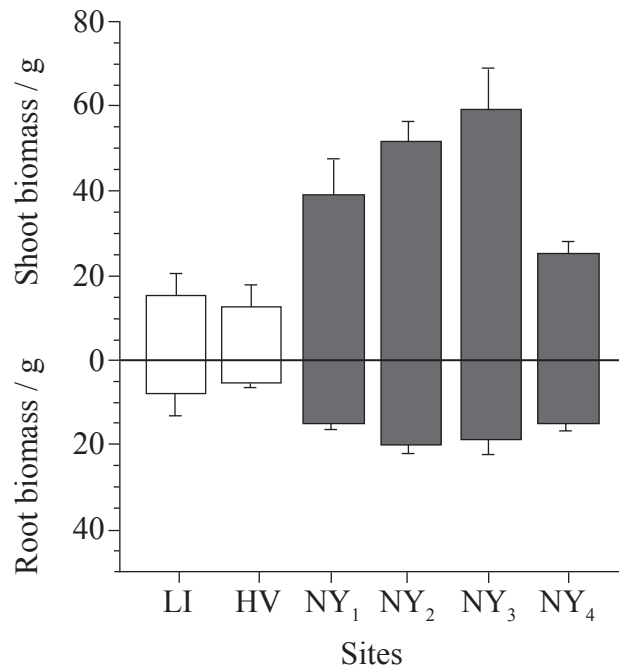
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(Question 1 continued)

Tree planting has been suggested as a way of improving air quality in urban areas. The growth of *Populus deltoides* in urban and rural areas near New York was investigated. Trees were grown in pots containing the same type of soil in all areas. High levels of mineral nutrients in the soil ensured that lack of nutrients was not the limiting factor on growth rates. The growth of the trees above ground (shoot biomass) and below ground (root biomass) was measured after one year. The bar chart below shows the results for two rural areas (open bars) and four urban areas (filled bars).



[Source: JW Greg, *et al.*, (2003), *Nature*, **424**, pages 183–186]

- (b) Outline the conclusions that can be drawn about the growth of *Populus deltoides* from the data in the bar chart.

[2]

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(Question 1 continued)

- (c) Discuss whether the differences in growth rates of *Populus deltoides* between urban and rural areas could be due to

- (i) differences in the acidity of rain.

[1]

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- (ii) differences in the concentration of air pollutants.

[2]

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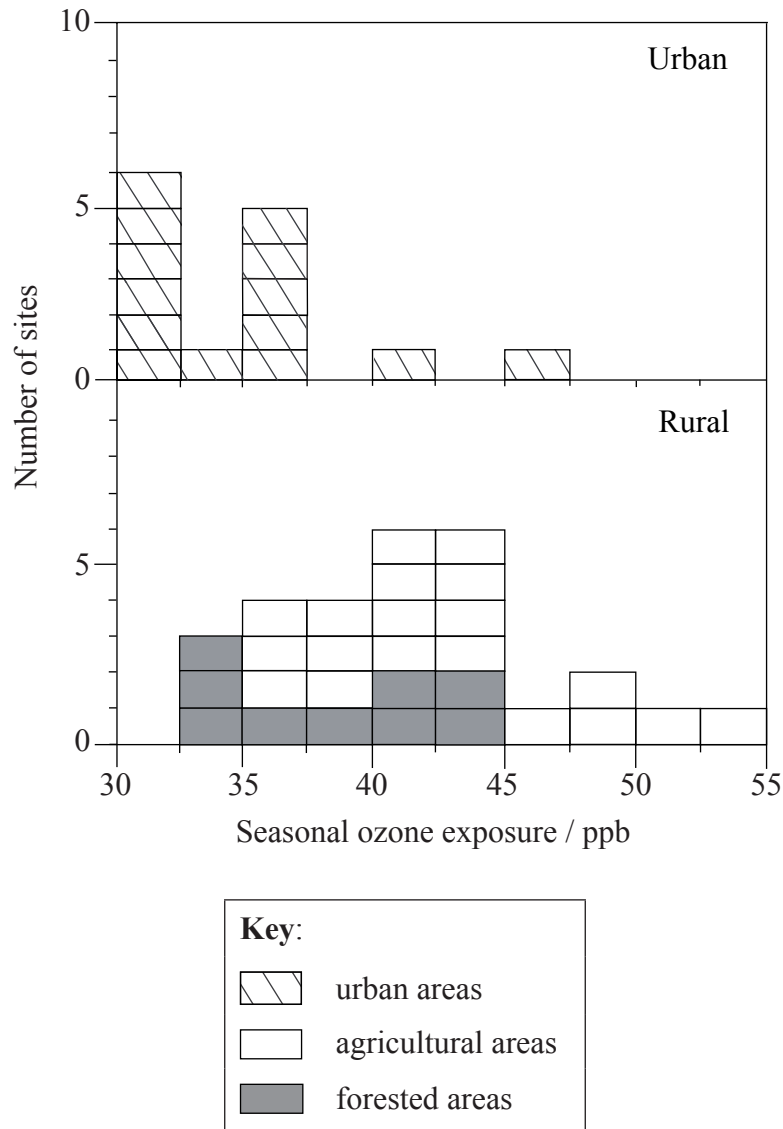
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(Question 1 continued)

The histograms below show the range of ozone exposure between May and September in urban and rural areas near New York.



[Source: JW Greg, *et al.*, (2003), *Nature*, **424**, pages 183–186]

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(Question 1 continued)

- (d) Compare the seasonal ozone exposures in urban, agricultural and forested areas. [2]

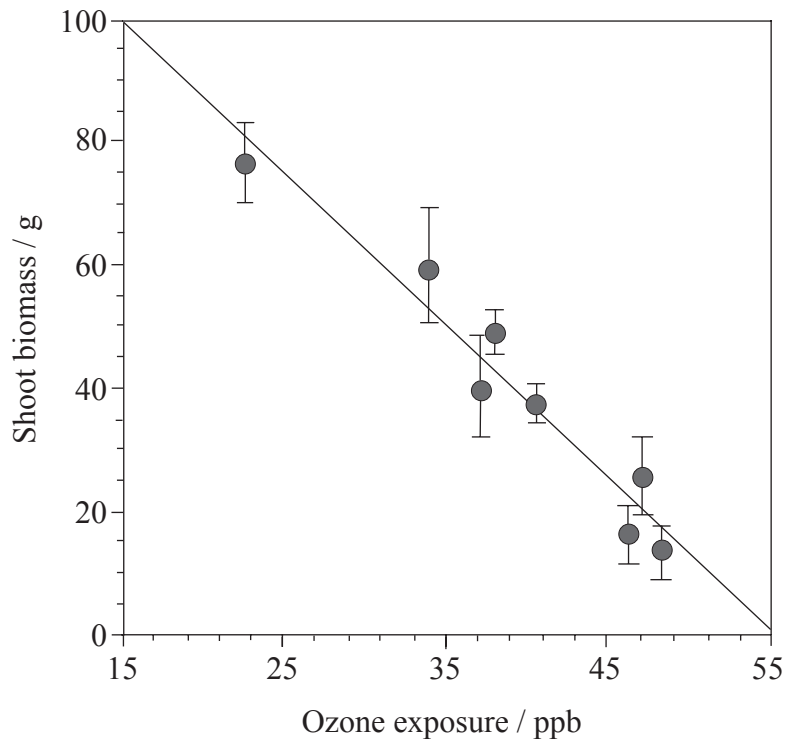
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(Question 1 continued)

The concentrations of ozone and the shoot growth of *Populus deltoides* were measured at eight sites. The results are shown in the scattergraph below.



[Source: JW Greg, *et al.*, (2003), *Nature*, **424**, pages 183–186]

- (e) Using the data in the scattergraph and in previous parts of this question, suggest a hypothesis for differences in the growth of *Populus deltoides* between urban and rural areas. Give reasons for your hypothesis. [3]

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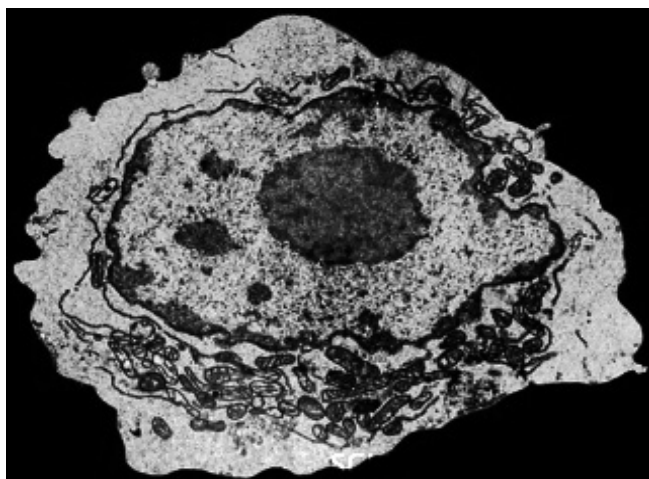
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2. The micrograph below shows an adult human stem cell.



[Source: www.sciencephoto.com/images/download_lo_res.html?id=714420159]

- (a) The cell cycle can be divided into two parts: interphase and mitosis.

- (i) Identify, with a reason, whether the stem cell in the micrograph is in interphase or mitosis. [1]

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- (ii) Deduce **two** processes that occur in human cells during this part of the cell cycle, but not during the other part. [2]

1.

2.

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(Question 2 continued)

- (b) State **two** characteristics of stem cells that can be used to distinguish them from other body cells. [2]

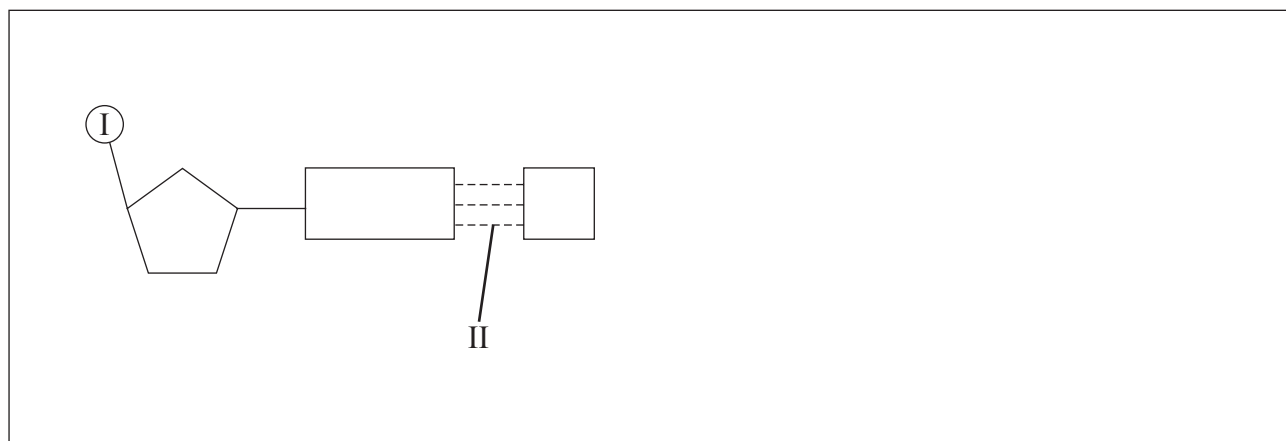
1.
2.

- (c) Outline **one** therapeutic use of stem cells. [3]

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3. The diagram below shows one DNA nucleotide and part of a second nucleotide.



- (a) State the names of structures I and II. [1]

I.

II.

- (b) On the diagram above, draw the structures that are missing from the second nucleotide. [1]

- (c) The two nucleotides would be permanently separated during DNA replication. State **one** process during which they would be temporarily separated. [1]

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- (d) Outline the method that can be used to amplify small quantities of DNA to obtain large enough quantities for DNA profiling. [2]

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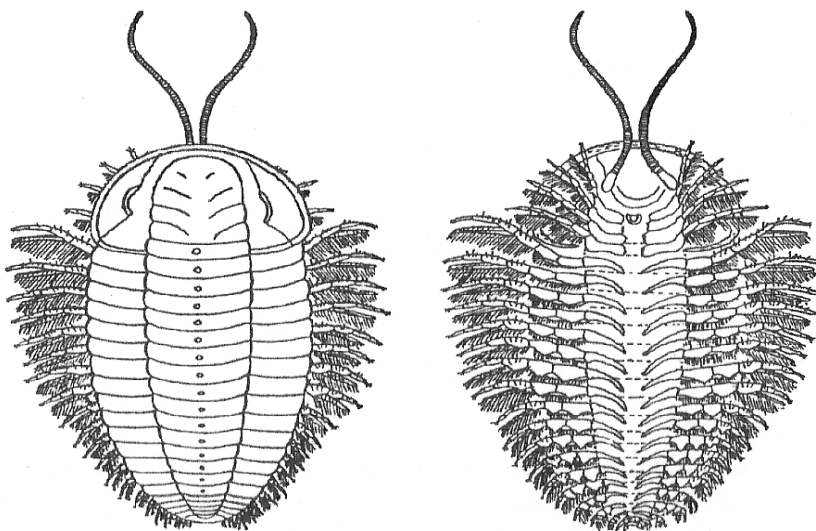
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4. *Triarthrus* was a trilobite that lived on Earth about 500 million years ago. The diagrams below show its structure, viewed from above and below. The structure was discovered by studying fossils of *Triarthrus*.



[Source: R Fortrey, (2000), *Trilobite!*, page 62]

- (a) There are many animals living on Earth today that belong to the same phylum as the trilobites, but there are no living trilobites. Deduce, with a reason, the phylum to which *Triarthrus* belonged. [2]

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- (b) Outline the evidence for evolution provided by fossils. [2]

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(Question 4 continued)

- (c) Some trilobites swam in clear, shallow water and had very large eyes. Suggest how species with large eyes could evolve from species with smaller eyes. [2]

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SECTION B

Answer **two** questions. Up to two additional marks are available for the construction of your answers. Write your answers in the boxes provided.

5. (a) Membrane proteins vary in their positions within the membrane and in their functions. Outline the positions and functions of proteins in membranes. [8]
- (b) Explain how polar and non-polar amino acids help channel proteins and enzymes carry out their functions. [5]
- (c) Compare competitive and non-competitive inhibition of enzymes. [5]
6. (a) During a period of physical exercise, the rate of urine production falls, but the ventilation rate and the body temperature rise. Explain the mechanisms that are used to cool the body when it is overheated. [5]
- (b) Explain how the collecting ducts can alter the volume of urine produced by the kidney. [5]
- (c) Describe the structure of the ventilation system, including the alveoli. [8]
7. (a) Gametes are produced in humans by spermatogenesis and oogenesis. Compare spermatogenesis and oogenesis. [5]
- (b) Explain the processes that result in genetic variation in the sperm produced by an adult male. [5]
- (c) Outline the process of *in vitro* fertilization (IVF). [8]
8. (a) All organisms in an ecosystem are involved in the carbon cycle. Outline the roles of living organisms in the carbon cycle. [8]
- (b) Explain how triose phosphate is produced and used in the chloroplasts of a plant. [5]
- (c) Explain the conditions that are needed to allow a seed to germinate. [5]



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